Instruction/
Example

2018 DOE Vehicle Technologies Office 30-Minute Annual Merit Review Oral Presentation

(replace with your title)

P. I. Name (always include)

Presenter Name (if not the P.I.)

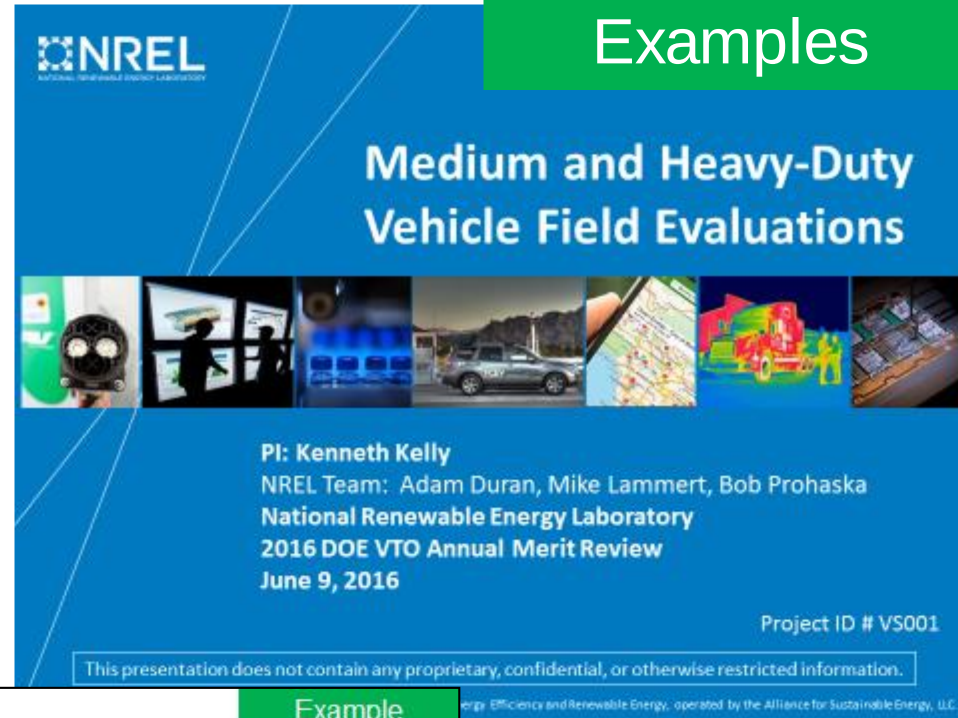
Organization

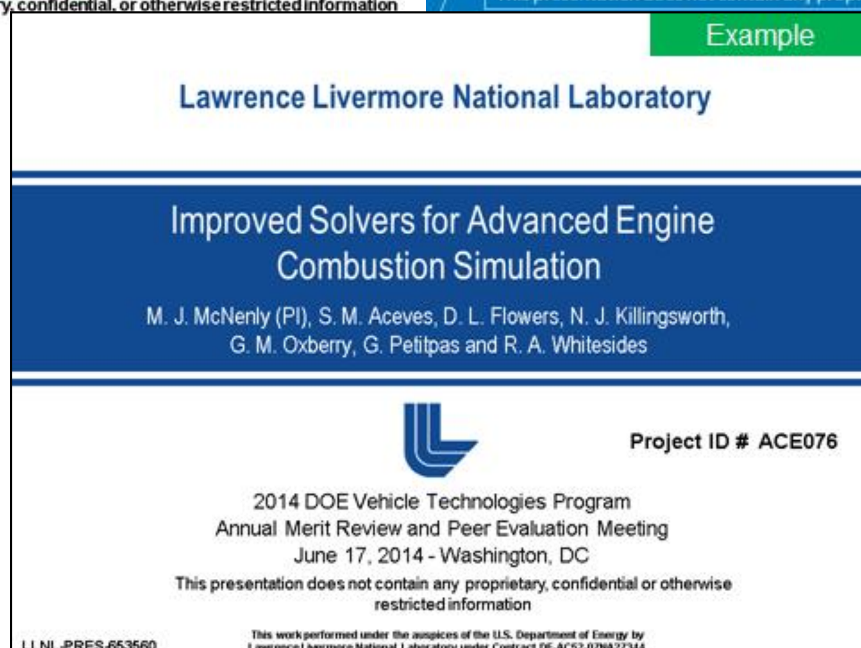
Date

Project ID #

(this will be provided to you)

Title Slide Examples





Mandatory Overview Slide

- Please prepare an Overview slide formatted and containing the information per the following slide:
  - Timeline (please confirm dates with your DOE HQ/NETL manager(s))
  - Budget (please confirm values with your DOE HQ/NETL manager(s))
  - Barriers (please list up to three technical barriers and technical targets from the most recent U.S. DRIVE Roadmap addressed by your project to be found at: https://energy.gov/eere/vehicles/us-drive-partnership-plan-roadmaps-and-accomplishments. If you don't see a report on your subject matter, please contact the relevant technology manager.
  - Partners

Instruction

Overview

Timeline

- Project start date
- Project end date
- Percent complete

Budget

- Total project funding
  - DOE share
  - Contractor share
- Funding for FY 2017
- Funding for FY 2018 (if available)

Barriers

- Barriers addressed
  - List up to 3 technical barriers and technical targets from the most recent U.S DRIVE Roadmap relevant to your project. For a list of roadmaps by subprogram please see the link below. If you don't see a report on your subject matter, please contact the relevant technology manager: https://energy.gov/eere/vehicles/us-drive-partnership-plan-roadmaps-and-accomplishments

Partners

- Interactions/collaborations
- Project lead

Overview Slide Examples

Overview

Project Outline

MAHLE Powertrain

Timeline

Start Date: February 1, 2012

End Date: January 31, 2015

Percent Complete: 70%

Project Goals/ACE Barriers Addressed

- 45% thermal efficiency on a light duty SI engine with emissions comparable to or below existing SI engines *(A, B, C, D, F)*
- 30% predicted drive cycle fuel economy improvement over comparable gasoline engine vehicle *(A, C, H)*
- Cost effective system requiring minimal modification to existing hardware *(G)*

Budget

Contract Value (80/20): $ 3,172,779

Gov't Share:	$	2,499,993
MPT Share:	$	672,796

Funding received in FY2013: $ 494,361

Funding for FY2014: $ 299,618

Partners & Subcontractors

Ford – Test engine platform

DELPHI – Custom injector design and development

MAHLE Powertrain LLC

Overview

Timeline

- Project start March 2014
- Project end March 2017
- 5% complete

Budget

- FY14-17 = $300 K (DOE)

Barriers

- Performance: Meet or exceed the performance of current forged crankshafts. (as-cast UTS > 800MPa, YS > 615MPa)
- Life: Material and process must achieve local ultra-high cycle fatigue requirements of current baseline
- Cost: no more than 110% of production cast units

Project Partners

- Caterpillar, Inc. – Lead
- Argonne National Laboratory
- General Motors
- Northwestern University
- University of Iowa

Overview

Timeline

- Project (CRADA) start date: May 28, 2009
- Project (CRADA) end date: Sept. 28, 2013
- Percent complete: 100%

Budget

- Total project funding
  - DOE share: $1.0M
  - GM in-kind cost share: $780K
- FY13 funding
  - DOE share: $100K (carryover from FY12)
  - GM in-kind cost share: $200K
- FY14 funding
  - $0 (project completed, follow-on ORNL-GM joint proposal submitted to FOA 991)

Barriers

- 10-15% energy generated in an IC engine is lost to parasitic friction, which is governed by the engine lubricant.
- Low-viscosity engine oils increase fuel economy but post challenges on wear protection.
- Emission catalysts 'poisoned' by conventional anti-wear additives.

Partners

- CRADA partner: General Motors
- Other collaborators: Lubrizol and Cytec Industries

This presentation does not contain any proprietary, confidential, or otherwise restricted information

Instruction

Relevance

- Relevance counts for 20% of your total project score.
- The title of these slides should make it clear that they count toward your project's relevance.
- Information to include:
  - Objectives: Describe the objective of your project and what you were to achieve in the work covered by your presentation, i.e., the objective of your work over the past year (March 2017–March 2018)
  - Your objectives should make it clear what the relevance of your project is to the VT Office (more information on the VT Office can be found through this Web site and its contained links: http://energy.gov/eere/vehicles/vehicle-technologies-office
  - The impact your project has on addressing the barriers identified in the Overview slide and other specific targets and milestones.

Relevance Slide Examples

Relevance for Addressing Barriers

- **Cost**
  - Seek to improve cost effectiveness of fuel-saving HEV technology
- **Technical target setting**
  - Establish targets for device developers focused on cost-effective fuel-saving goal
  - Confirm performance of candidate devices in vehicle systems context
- **Risk aversion and constant advances in technology**
  - DOE/NREL helping to evaluate technologies outside the traditional HEV ESS paradigm
  - Reusable test platform can be used to evaluate different systems as they become available—simply swapping out the LEESS devices under test

Relevance/Objectives

High Temperature DC-Bus Capacitors Cost Reduction and Performance Improvements

- Overall Objectives
  - Reduce the cost, size and weight of the DC-link capacitor by >50%
  - Increase durability in high temperature environments
- Objectives this period
  - Define size and shape of PML capacitor
  - Develop thermal-mechanical and electrical models of the Gen1 capacitor
  - Complete upgrade pilot line
  - Finalize PML dielectric
- Impact
  - Accelerate the manufacturing capability and mass production adoption of energy-efficient and cost-effective APEEM capacitor technologies into electric drive vehicles, such as electric vehicles (EVs), hybrid electric vehicles (HEVs), and plug-in hybrid electric vehicles (PHEVs)

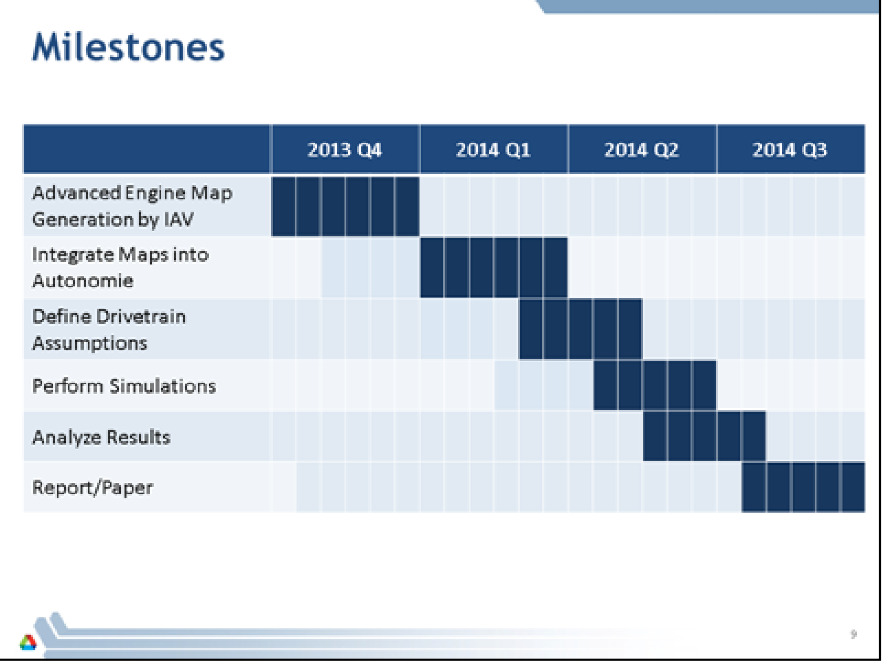
Project Objectives

- Demonstrate a 25% improvement in combined City FTP and Highway fuel economy for the Chrysler minivan
  - The baseline (reference) powertrain is the 2009 MY state-of-the-art gasoline port fuel-injected 4.0L V6 equipped with the 6-speed 62TE transmission
  - This fuel economy improvement is intended to be demonstrated while maintaining comparable vehicle performance to the reference engine
  - The tailpipe emissions goal for this demonstration is Tier 2, Bin 2
- Accelerate the development of highly efficient engine and powertrain technologies for light-duty vehicles, while meeting future emissions standards
- Create and retain jobs in support of the American Recovery and Reinvestment Act of 2009
- Project content is aimed directly at the listed barriers

Milestones

- Milestones may be presented in a separate slide directly before the Approach section or included as part of the Approach section
- Include milestones and go/no-gos for FY 2018 and FY 2019.

Milestones Example Slides



Milestones

Date	Milestones and Go/No-Go Decisions	Status
December 2013	Milestone: Identify high-potential motor material/designs for further optimization and cost reduction.	Complete.
March 2014	Milestone Complete initial modeling and simulation of most promising motor design.	Complete.
June 2014	Go/No-Go decision: Finalize characterization of motor materials and non-rare earth motor design prior to fabrication of prototype motor.	On track.
September 2014	Milestone: Complete fabrication of prototype motor.	On track.

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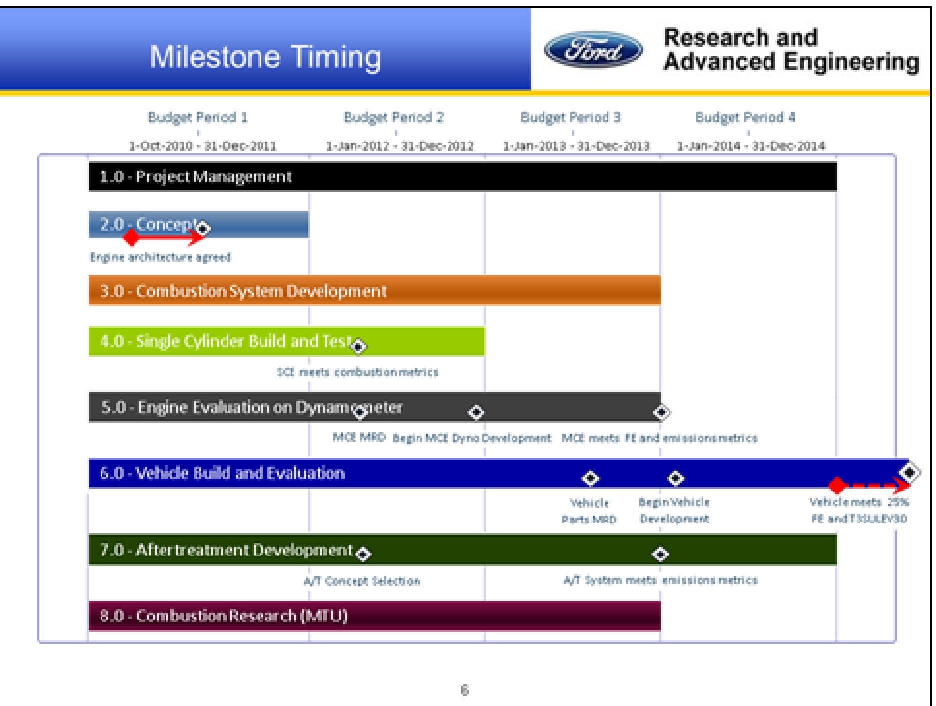
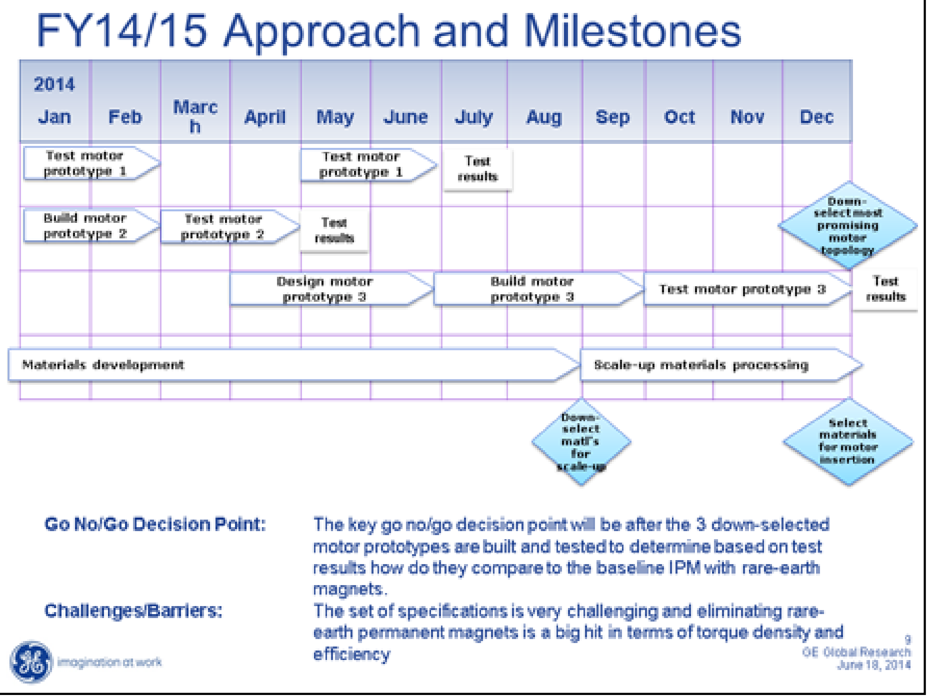


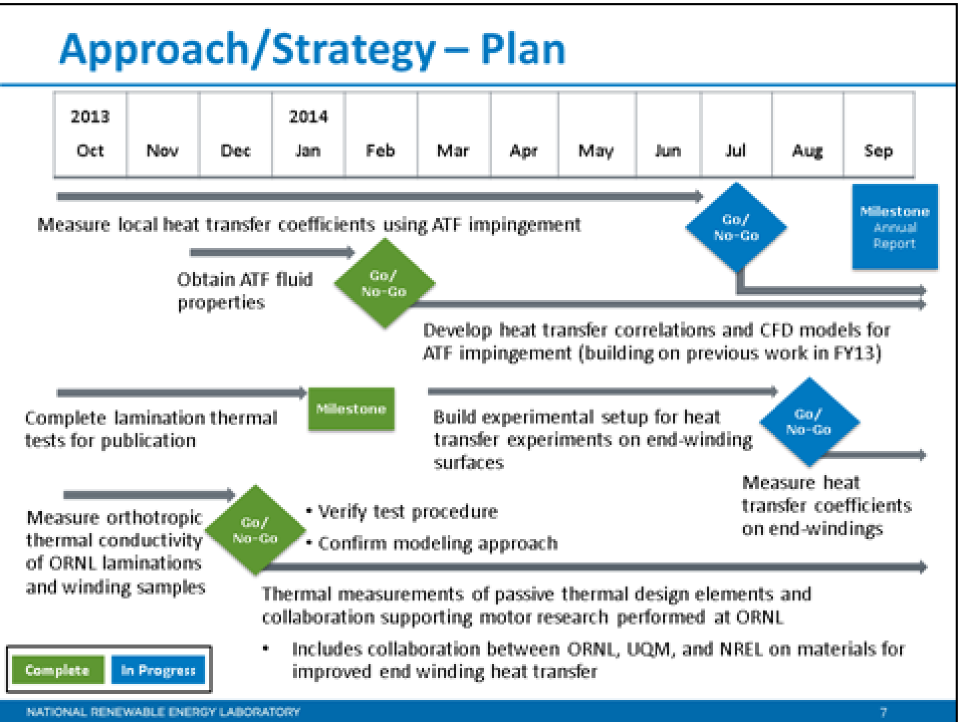
Instruction

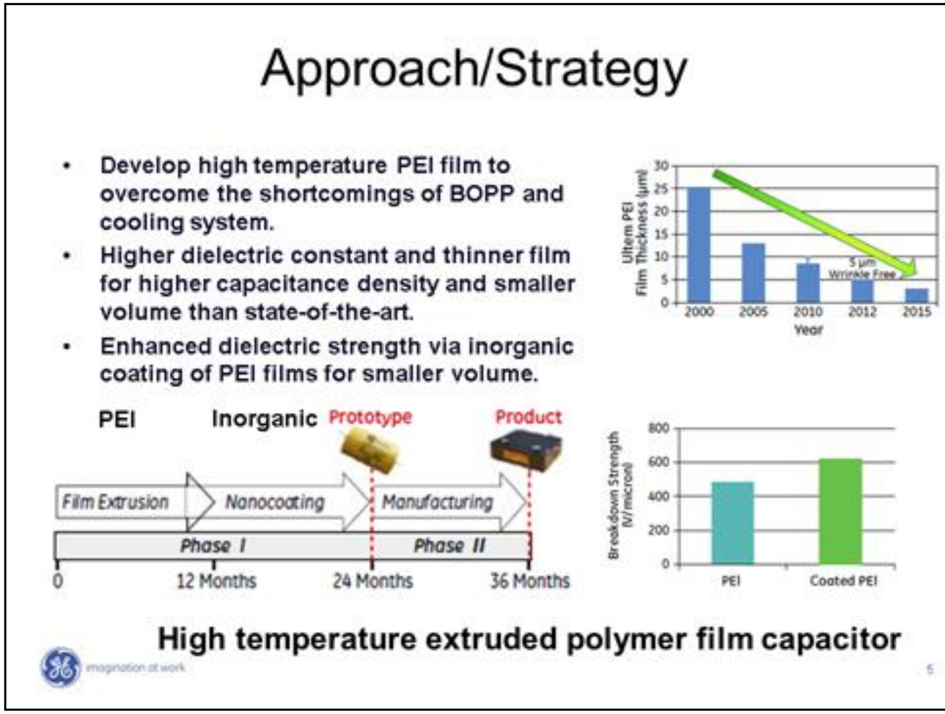
Approach

- Approach counts for 20% of your total project score.
- The title of your slides should make it clear that they count toward your project's Approach.
- Describe overall Technical Approach:
  - Emphasize unique aspects of your work and de-emphasize discussion of equipment used
  - Discuss how your work addresses the project's technical barriers
  - Describe how your project is integrated with other research or deployment projects within the VT Program.
  - Use simple statements so that scientists and engineers, not experts in your area, can readily understand the explanation of your approach.
- Include the planned milestones and go/no-go decisions for FY 2018 and FY 2019 and current status toward them (if not shown in a separate Milestone slide).

Approach Slide Examples







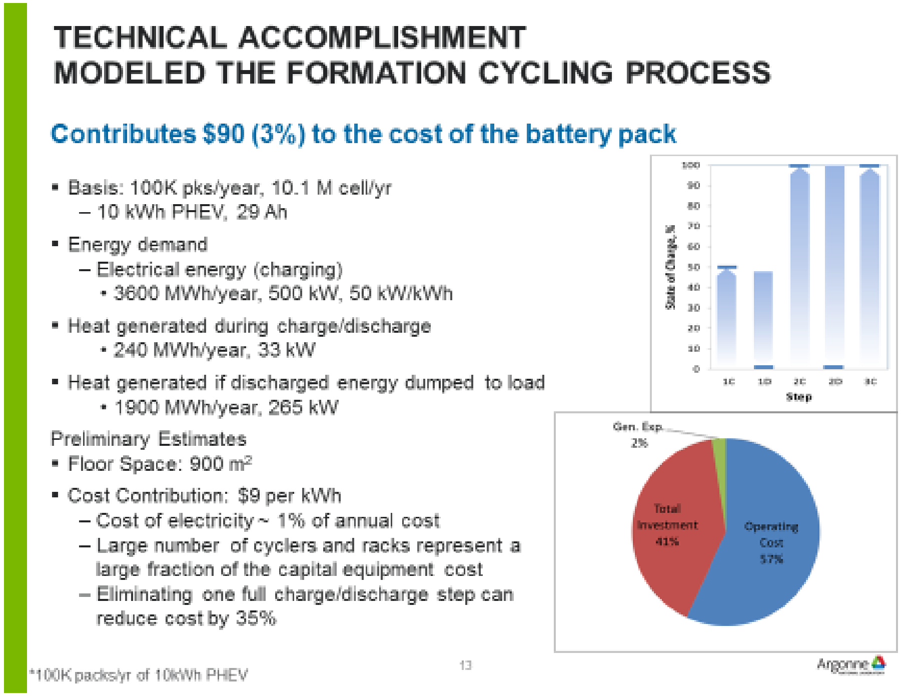
Technical Accomplishments and Progress

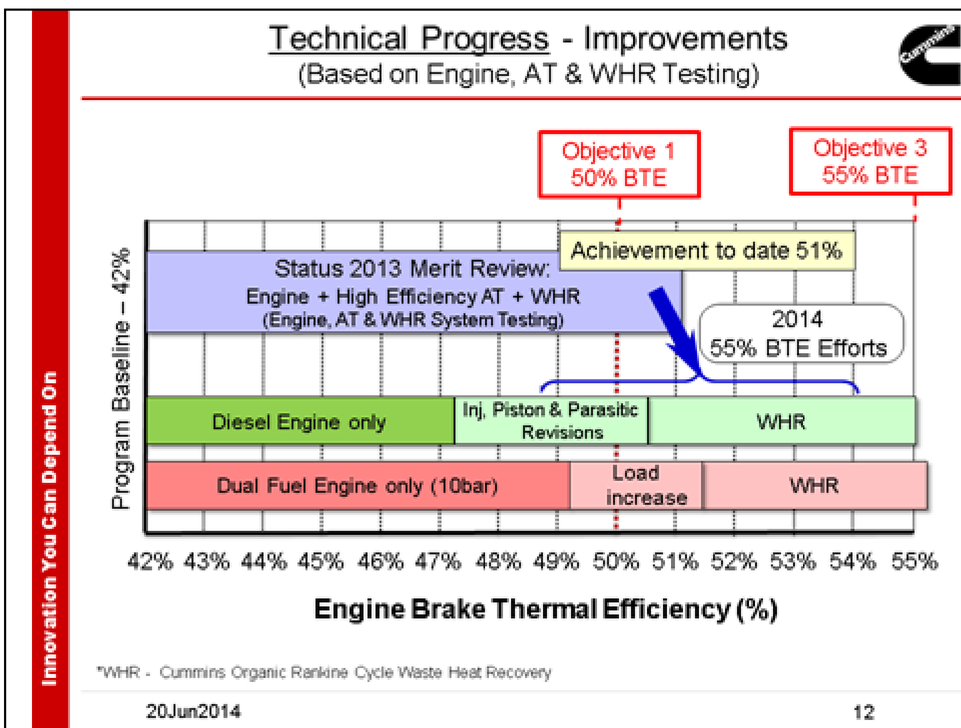
- Technical Accomplishments and Progress count for 40% of your total project score.
- The title of these slides should make it clear that they count toward your project's technical accomplishments and progress.
- Each slide should include a summary "take-home" message, especially those that contain data.
- **Describe the most important technical accomplishments achieved during the reporting period and their significance**. Specifically, address last year's reviewer comments regarding technical accomplishments and progress as well as progress to date for new projects.
- Include relevant data to support your accomplishments.
- <u>Relate the accomplishments to project milestones, barriers, objectives, and technical targets.</u>
- Benchmark the progress versus FY 2017 results, if applicable.

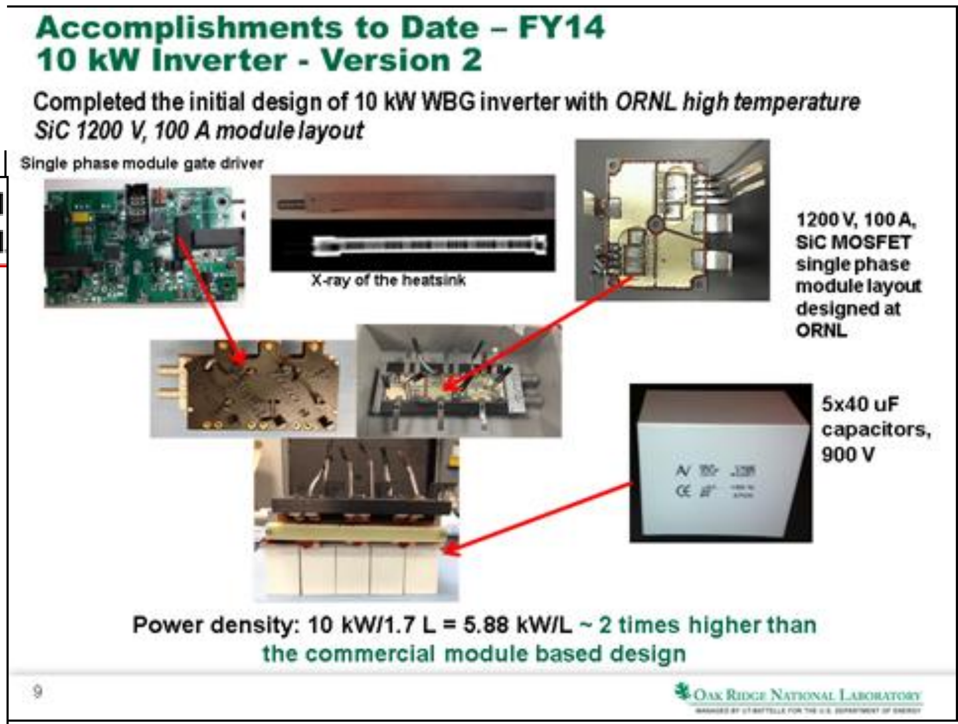
Technical Accomplishments and Progress (cont.)

- Include no more than one slide on previous accomplishments and CLEARLY indicate work previously presented versus new work!
- To assist the reviewers evaluating your work, please include bullet comments of the key points on each slide.
- Include sufficient slides to explain what was done leading to the technical accomplishments.
  - However, please limit your slides to the time you have available – the 20-minute presentation time will be STRICTLY enforced!
- Though your presentation will be in color, it is best to choose colors and data symbols that can be easily distinguished in black and white for those reviewers using hardcopies.

Accomplishment Slide Examples







Responses to Previous Year Reviewers' Comments

- If yours is an on-going project that was reviewed last year, address 1-3 significant questions/criticisms/ recommendations from the previous year's reviewers' comments, available at: https://energy.gov/eere/vehicles/downloads/2017-annual-merit-review-report
- Last year's presentations can be found at: https://energy.gov/eere/vehicles/annual-merit-review-presentations

If your project was not reviewed last year, please indicate as such on the slide.

Reviewer Comment Slide Examples

CHRYSLER

Response to Previous Years Comments

Notes: (1) Comments taken form the 2013 AMR evaluations.

Comments from the 2013 Annual Merit Review[1]	Response
"The reviewer suggested that it may be beneficial to try to determine the discrepancy between the real world fuel economy observed and that determined using the federal test procedures due to the magnitude of the difference."	**Actions Taken** • Chrysler LLC followed federal test procedures to run the California Exhaust Emission Standards test for EAER in Phase II. The discrepancy between real world fuel economy observed and federal test procedures results were compared between Phase I and Phase II. **Status** • Phase I and Phase II comparison displayed a similar magnitude of difference in fuel economy. This discrepancy is due to the difference between the specified test sequences and real world driving habits.
"The reviewer said that it would have been informative to understand what transpired in the relationship with the first battery manufacturer."	**Actions Taken** • There were complications that arose during the battery manufacturing scale-up, which led to the observed field issues. These issues could not be resolved without complete replacement of the battery cells. A new supplier replaced the batteries, as the previous supplier could not meet all the required criteria (manufacturing performance and quality) in the required time frame of the program. **Status** • Current observations show that the new cells implemented in Phase II vehicles for real world testing meet or exceed all performance requirements. All previous issues have been eliminated.
"The reviewer was uncertain about which of this project's technical accomplishments had not already been learned by others before, with the exception of the reverse flow capability."	**Actions Taken** • Phase II vehicle deployment implements testing of unique technology including AC Power Generation, Smart Charging, Reverse Power Flow, Power Panel, development of level 1 and 2 DC charging and ATPZEV compliance all on a full size pickup truck platform. The results to applied to future programs. **Status** • Real world data on new technology is being collected by deployment partners.

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Responses to Previous Yea

- This project is a new start.

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Response to reviewers comments

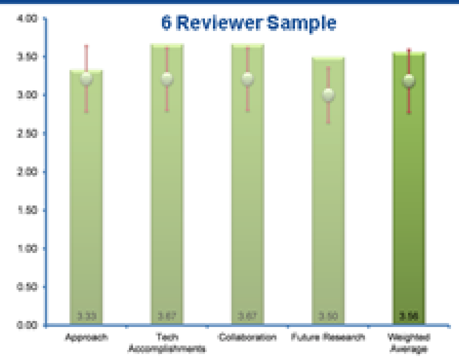
AMR13 comments were generally positive with the reviewers posing three basic questions:

1. *Is it correct?*

The LLNL thermochemistry library has been verified against other available solvers (Cantera, Chemkin & TChem) and is found to agree to within a relative tolerance of O(10^{-4}) – corresponding to the difference in molecular weights and physical constants. The adaptive preconditioner solver has been verified against traditional direct approaches. The ignition delay times and major species concentrations have a relative accuracy within an order of magnitude of the integrator tolerance and typically achieve an accuracy of O(10^{-7}).

2. *Has it been validated for HECC engines?*

The simulation validation for HECC engines is led by the ACE-012 project at LLNL, and is featured in Whitesides presentation at AMR14. We actively collaborate to ensure that the new solvers are applicable to engine CFD simulation, with this project leading the verification effort.



3. *Do you still need to speedup chemistry?*

Depends on the number of multizones needed to accurately resolve combustion (see slide11). While this remains an open question, there are a number of simulations used in industry where the CFD transport is the dominant cost. This project is shifting its focus to accelerate other bottlenecks in HECC research: multispecies transport in CFD; mechanism development and debugging; and detailed spray dynamics.

Lawrence Livermore National Laboratory

McNenly, *et al.* LLNL-PRES-653560

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CRF

Responses to Previous Year Reviewers' Comments

Comment: *"Strengthen interactions with AEC partners wherever possible"*

Response: This year's work with Cummins/Converge adds to our explicit interactions, and others are in the works as well.

Comment: *"modeling needs to explain and predict results," "more fully leverage CFD modeling to assist in the understanding of the physical processes", "expand CFD activity"*

Response: We've redirected our modeling approach to do just that, as described in this year's report.

Comment: *"for future work, look at impacts of fuel injection pressure and hole size on post injection mixing and any clever nozzle/injection control strategies that could address various piston geometry impacts on observed performance", "look at effects of fuel injection pressure", "expansion to different geometries would be interesting"*

Response: This year, we studied injection pressure effects on dribble. Going forward, the new DFI-21 fuel injection system has lower static back leak and will allow us to go to higher injection pressures, and our new optical piston(s) will allow us to study couplings to chamber geometry.

Comment: *"not so clear that a unifying theory will emerge to generalize the results."*

Response: Agreed, but we will still try to take the conceptual model approach as far as it will go.

Comment: *"discuss the ISFC impacts", "evaluate the tradeoffs and dependencies between soot and engine efficiency", "emphasize heat transfer and efficiency"*

Response: These are hard to quantify in optical engines, but the planned heat transfer work should help to address this, and we are using modeling results to aid quantification in this regard as well.

Comment: *"In the long term, expand to pilot injections"*

Response: Our long term plan to develop a multiple injection conceptual model includes pilot injections.

Combustion Research Facility   ACE001 Musculus 24/25   Sandia National Laboratories

Collaboration and Coordination with Other Institutions

- Collaborations and Coordination with Other Institutions count for 10% of your total project score.
- The title of these slides should make it clear that they count toward your Collaborations and Coordination with Other Institutions.
- List your project collaborators, indicating:
  - Relationship (i.e., prime, sub, etc.)
  - Industry, university, national laboratory
  - Within or outside the VT Office
  - Extent of the collaboration.

Collaboration Slide Examples

CHRYSLER

Partnerships / Collaborations

Argonne	Providing computational fluid dynamics (CFD) modeling, spray measurements, and in-cylinder combustion high-speed imaging to support combustion development and control
BOSCH	Supplied fuel injectors, lines, pumps, harnesses and controllers for the DI gasoline and DI diesel fuel systems, and collaborated with Chrysler to integrate the injector drivers
DELPHI	Supplied Ion Sense coils and developing combustion feedback system to allow closed loop combustion control
THE OHIO STATE UNIVERSITY	Developed Vehicle Energy Simulator (VES) and supervisory controller (Vehicle Energy Manager – VEM) that oversees and integrates energy managem

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Partners/Collaborators

- International Rectifier — GaN devices (engineering samples) and modules, requirements for gate drivers
- Delphi — Packaged GaN power modules
- Aegis Technology Inc. — light-weight, low loss nano-magnetic materials
- Hitachi/Metglas — input on design and fabrication of high frequency inductors and transformers using FINEMET
- Ferroxcube USA— input on design and fabrication of high frequency inductors and transformers using

Oak Ridge National Laboratory

Collaborations and Coordination

Collaborations

MAHLE Powertrain

- **Ford Motor Company** – Project Partner
  - Donated engine hardware, offered operational advice on optical engine, will participate in data sharing
- **Delphi Corporation** – Project Subcontractor
  - Supplied pre-chamber fuel injectors and are conducting CFD analysis on fuel injection characteristics
- **Spectral Energies LLC** – Project Subcontractor
  - Acquired optical engine data, contributed to post-processing
- **University Collaboration**
  - Engaged multiple universities concerning further TJI investigation

MAHLE Powertrain LLC

Remaining Challenges and Barriers

- Highlight the key remaining challenges and barriers to meeting the project objectives.
- The remaining challenges and barriers should provide justification and support for the future plans in the following slide.

Barriers and Challenges Slide Examples

Remaining Challenges and Barriers

Cooling Technology Development

- Correlations of ATF impingement cooling on motor windings
- CFD simulation of ATF impingement cooling
- Variation in local heat transfer coefficients of ATF impingement
- Effective convective heat transfer coefficients for representative end-windings

Passive Thermal Stack and Reliability

- Thermal tests of interfaces and materials for motor cooling
  - Slot-windings
  - End-windings
- In-situ thermal resistance measurements

NATIONAL RENEWABLE ENERGY LABORATORY 21

Remaining Challenges and Barriers

- A primary challenge for full integration of *in situ* gas reaction technology into our research program will be to correlate *in situ* reactions under "real" catalytic conditions with standard bench-top reactor experiments on bulk catalysts. These experiments will be conducted with ongoing research collaborators.
- In parallel, the ultimate utility of the ex situ reactor capability we have developed for use with Protochips heater technology will depend on the successful fabrication and beneficial use of a new "transfer" holder to protect the specimen when it is moved between microscope and reactor.

18 2014 AMR — Oak Ridge National Laboratory

Remaining Challenges and Barriers

- ***In engine simulations with large mechanisms that employ multi-zone and advanced solvers: species advection/diffusion can be as expensive as chemistry.***
- ***GPU effectiveness depends on coupling together integration of many CFD cells and on hybrid GPU/CPU algorithms to determine optimal coupling/workload balance.***
- ***Need for systematic reconciliation of uncertainties in experimental and modeling parameters and results.***
- ***Non-chemistry sub-models lack general predictive capability (e.g. fuel sprays and soot models).***

We will address these issues in our future work.

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Proposed Future Research

- Proposed Future Research counts for 10% of your total project score.
- The title of these slides should make it clear that they count toward your Proposed Future Research!
- Explain what it is you plan to do during the rest of this year (FY 2018) and next year (FY 2019). Provide justification for future plans.
- Add the statement to all slides with future-looking statements, "Any proposed future work is subject to change based on funding levels."
- Be as specific as possible; avoid blanket statements.
- Highlight upcoming key milestones.
- Address how you will deal with any future decision points during that time and any remaining issues or barriers, including any alternative development pathways under consideration to mitigate risk of not achieving milestones.

Future Research Slide Examples

Proposed Future Work

FY16-FY18 Proposed Work will In

During the FY16 year, the Fleet Evaluations w
with Idaho National Lab and Argonne Nation
Technology Evaluations. Under this activity,

1. Coordinate with DOE's VTO technology managers, medium and heavy-duty industry, and fleet partners to identify and select high-priority vehicle technologies for evaluation
2. Coordinate medium and heavy-duty evaluation activities with other DOE program activities (such as 21CT, NCFP, and energy storage) and laboratory partners (e.g., INL, ANL, ORNL, and LLNL)
3. Conduct medium and heavy-duty vehicle technology testing, data collection, and evaluation activities
4. Report on results from all medium and heavy-duty vehicle technology activities.

Separate to this activity, NREL will continue to seek opportunities to ***expand and apply existing data and expertise*** to support government, industry, and research partners in the development of advanced vehicle technologies through DOE-sponsored industry awards, DOE VTO programs, other government state and federal agencies, and "Work-for-others"

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Future Work

Upcoming Project Work and Challenges

MAHLE Powertrain

Key Challenges

- Challenge: Achieving 30% vehicle drive-cycle fuel economy improvement with TJI
  - Multi-cylinder TJI engine testing is necessary to determine accurate brake specific fuel consumption
- Challenge: Development of TJI operating strategy
  - An appropriate operating strategy is necessary to translate positive thermal efficiency results into real-world fuel economy savings across the operating map
    - Spark timing, auxiliary fuel injection pressure/timing/quantity, valve timing, etc.
  - Provide understanding of the limitations o TJI application across the operating map

Future Work

- Phase 2B:
  - Complete Phase 2B engine testing
    - Complete design optimization
    - TJI operating strategy development
    - In-pre-chamber RGF and AFR determination
  - Complete CFD model correlation to non-fueled experimental data
- Phase 3:
  - Multi-cylinder engine build and installation
  - Complete multi-cylinder engine testing
    - Mini-map generation

17 | MAHLE Powertrain LLC

Future Work – We will continue to explore strategies for improving efficiency and accuracy of chemistry and engine CFD

Ongoing

FY14 – [Q3 Milestone] Complete the mechanism diagnostic and debugging suite of tools

FY14 – [Q4 Milestone] Improve high fidelity multizone chemistry on the GPU for engine CFD simulations

FY14 – Continue to improve availability within the MOU for the new solvers – pursue online version of mechanism diagnostic tools

Proposed supports diesel research in ACE012, ACE013

FY15 – Accelerate multispecies diffusion and advection algorithms
- Direct algorithm improvements
- New GPU transport algorithms
- Reduced order models with error control

FY15 – Add more applications to the turnkey package of the chemistry solvers (diffusion flames, extinction, sensitivity, *etc.*)

Planned future solvers for use in CFD packages

FY15/16 – Rigorous error analysis of the multizone combustion solver for direct user control

FY15/16 – Accelerate detailed spray dynamics algorithms

Lawrence Livermore National Laboratory

McNenly, *et al.* LLNL-PRES-653560

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Mandatory Summary Slide

- Summarize the key points you wish the reviewers and the audience to take away from your presentation.
- For those projects that are working toward specific technical targets, include a Summary Table summarizing key technical results to date in FY 2018 compared to FY 2017 results, and the technical targets.

Summary Slide Examples

SUMMARY

- The Phase 3 GM 2.0L turbocharged engine updated to 11.0:1 compression ratio, high energy ignition system, and cooled LPL EGR hardware has been tested for fuel efficiency and power.
  - *Fuel efficiency was improved by a weighted average of 3.2% over the baseline*
  - *Peak power was reduced from 180 to 165*
  - *Torque was improved at low engine speeds*
- The Phase 4 2.0L turbocharged engine design and build was completed by the end of the 4th quarter 2013.
- Testing of the updated Phase 4 2.0L turbocharged engine has begun. Testing is scheduled to be completed by the end of the 4th quarter 2014.

GM

Summary

Relevance

- Develop integrated cell with dry electrode, direct coated separator, and fast formation to accomplish 50% cost savings while maintaining 90% performance compared to baseline design

Approach

- Dry electrode
  Improve the micro-structure and morphology of the electrode and develop the process of automated pilot line for large format cell builds
- Water based cathode
  Develop an additive and new formulation for mixing and coating process improvements
- Direct coated separator
  Develop roll-to-roll process for scale-up to improve lamination strength and reduce thickness variation
- Fast formation
  Develop new activation process to improve cell uniformity using step-charging and step-aging process and develop an improved detection

Technical accomplishments

- Dry electrode
  The cells built with optimized dry electrode demonstrate 30% lower ASI and 10% higher rate capability than initial electrode design
- Water based cathode
  The results show 90% capacity at 2,500 cycles and similar performance compared to the baseline. The rate capability performance has been improved via an optimized pH balancer and conductive graphite.
- Direct coated separator
  The cells show 9% lower ASI and 27% better rate capability compared to the baseline
- Fast formation
  The results of the new activation process show lesser variation for 1st cycle capacity, impedance, dV and capacity retention after calendar life. The detection process at low SOC demonstrates improved detectability and lower cell degradation.

Proposed future research

- Deliver 24 15Ah final cells and final cost model to DOE
- Transfer technologies to production

Johnson Controls

Summary

COOPER TIRES

- Testing conducted to date indicates Cooper is on track to meet the goals of 20% weight reduction and 3% fuel savings.
- Phase II is on track for evaluation during 2nd Quarter of 2014.

Features	Contribution To Weight Reduction	Contribution To Low RR
Light weight Nano-fiber	1%-2%	5%
~~Light weight Bead~~	~~2% - 4%~~	~~Minimal~~
Light weight Belt	8%-14%	4%-6%
~~Light weight Inner Liner~~	8%	~~-5% to -10%~~
Ultra-Long Wearing & Ultra-Low RR Tread	1%-2%	15%-20%
Low RR Tire Profile	8%-10%	10%-12%
Total	~20%	~ 30%

Technical Back-Up Slides

(Note: please include a “divider” slide if you are including back-up technical slides [maximum of five]. These back-up technical slides will be available for your presentation and will be included in the web PDF files released to the public.)

Reviewer-Only Slides

- Publications and Presentations
- Critical Assumptions and Issues

(Note: please include a “divider” slide between those to be presented and the “Reviewer-Only” slides. These slides will be removed from the presentation file and the web PDF files.)

Reviewer-Only Slides

- The following slides are to be included in your submission for Peer Evaluation purposes, but will **not** be part of your oral presentation – they will be provided to reviewers only.

Publications and Presentations

- List any publications and presentations that have resulted from work on this project.
- Use at least 12-point font.
- Please verify that the links in your slides are active.

Note: This slide is for the use of the Reviewers only; it is not to be presented as part of your oral presentation. These Reviewer-Only slides will be included in the copy of your presentation that will be made available to the Reviewers.

Publications Example Slides

Recent Publications and Presentations

"Measuring Transient Entrainment Rates of a Confined Vaporizing Diesel Jet," ILASS Americas 26th Annual Conference on Liquid Atomization and Spray Systems, May 2014.

"A CFD Study of Post Injection Influences on Soot Formation and Oxidation under Diesel-like Operating Conditions," SAE Technical Paper 2014-01-1256, accepted to SAE Journal of Engines 7(2), April 2014.

"In-Cylinder Mechanisms of Soot Reduction by Close-Coupled Post-Injections as Revealed by Imaging of Soot Luminosity and Planar Laser-Induced Soot Incandescence in a Heavy-Duty Diesel Engine," SAE Technical Paper 2014-01-1255, accepted to SAE Journal of Engines 7(2), April 2014.

"Effect of Load on Close-Coupled Post-Injection Efficacy for Soot Reduction in an Optical, Heavy-Duty Diesel Research Engine," J.A. O'Connor and M.P.B. Musculus, paper ICEF2013-19037, ASME Internal Combustion Engine Fall Technical Conference, October 2013.

Encyclopedia article: "Experimental Facilities and Measurements – Fundamentals," to appear in "Encyclopedia of Automotive Engineering," M.P.B. Musculus, L.M. Pickett, S.A. Kaiser, accepted June 2013.

"Post Injections for Soot Reduction in Diesel Engines: A Review of Current Understanding," J. A. O'Connor and M.P.B. Musculus, SAE Technical Paper 2013-01-0917, SAE Int. J. Engines 6:400-4219, May 2013.

"Optical Investigation of the Reduction of Unburned Hydrocarbons Using Close-Coupled Post Injections at LTC Conditions in a Heavy-Duty Diesel Engine," J.A. O'Connor and M.P.B. Musculus, SAE Technical Paper 2013-01-0910, SAE Int. J. Engines 6:379-399, May 2013.

"Optical Investigation of Multiple Injections for Unburned Hydrocarbon Emissions Reduction with Low-Temperature Combustion in a Heavy-Duty Diesel Engine," J.A. O'Connor and M.P.B. Musculus, Paper # 0701IC-0033, 8th US National Meeting of the Combustion Institute, Park City, UT, May 2013.

"Effects of EGR and Load on Soot in a Heavy-Duty Optical Diesel Engine with Close-Coupled Post-Injections for High Efficiency Combustion Phasing," J.A. O'Connor and M.P.B. Musculus, Int. J. Eng. Res. in press, published online July 2013.

"Sandia Maps Multiple Paths to Cleaner, Low-Temp Diesels," SAE Truck and Bus Engineering Online, http://www.sae.org/mags/TBE/12411, September 2013.

Invited presentation: "Thinking into the Box: Solving Engineering Problems Using Lasers and Cameras in Optical Engines," Institute for Sustainable Energy seminar series, University of Alabama, Tuscaloosa, Alabama, April 2013.

Invited presentation: "Optical Diagnostics for Diesel Engine Combustion and
presentation to technical staff at John Deere, Waterloo, IA, July 2013.

Invited presentation: "A Conceptual Model for Low-Temperature Diesel Comb
Engines & Vehicles, Capri, Italy, September 2013.

Publications

- Greene, D. L., S. Park, and C. Liu (2014). Towards a Public Policy Framework for Energy Transition: Modeling the Transition to Electric-Drive Vehicles (to be submitted).
- Greene, D. L., S. Park, and C. Liu (2014). The Economics of a Transition to Electric Drive Vehicles in the United States: The Implications of Deep Uncertainty, Tipping Points, Network Externalities and Imperfect Markets for Public Policy, White Paper 1-14, Howard H. Baker, Jr. Center for Public Policy, University of Tennessee.
- National Research Council (2013). Transitions to Alternative Vehicles and Fuels. Washington, DC: The National Academies Press.
- Greene, D. L., S. Park, and C. Liu (2013). Analyzing the Transition to Electric Drive Vehicles in the U.S., Futures, Available online 19 October 2013, ISSN 0016-3287, http://dx.doi.org/10.1016/j.futures.2013.07.003.
- Greene, D. L., C. Liu, and S. Park. (2013). Transition from Petro-Mobility to Electro-Mobility. In Transition to Renewable Energy Systems, Wiley-VCH Verlag GmbH & Co. KGaA: 849-873
- Greene, D. L., S. Park, and C. Liu (2013). Analyzing the Transition to Electric Drive Vehicles in California., White Paper 4-13, Howard H. Baker, Jr. Center for Public Policy, University of Tennessee.

Publications and Presentations

Invited Presentations

Szybist, J.P., Splitter, D.A., Kalaskar, V.B., Pihl, J.A., and Daw, C.S., "An Investigation of Non-Catalytic In-Cylinder Fuel Reforming," Southwest Research Institute HEDGE Consortium Meeting, (June 4th, 2013, Southwest Research Institute, San Antonio, TX).

Szybist, J.P., Splitter, D.A., Kalaskar, V.B., Pihl, J.A., and Daw, C.S., "An Investigation of Non-Catalytic In-Cylinder Fuel Reforming," 2013 SAE International High Efficiency Internal Combustion Engine Symposium, (April 14th, 2013, Detroit, MI).

Peer Reviewed Journals, ORNL Reports, and Conference Proceedings

Szybist, J., Steeper, R., Splitter, D., Kalaskar, V. et al., "Negative Valve Overlap Reforming Chemistry in Low- Oxygen Environments," *SAE Int. J. Engines* 7(1):2014, doi:10.4271/2014-01-1188.

Kalaskar, V.B., Szybist, J.P., Splitter, D.A., Pihl, J.A., Gao, Z., and Daw, C.S., "In-Cylinder Reaction Chemistry and Kinetics during Negative Valve Overlap Fuel Injection under Low-Oxygen Conditions," ASME ICEF Proceedings, Technical Paper 2013-19230, 2013.

Szybist, J.P., Chakravathy, K., and Daw, C.S., "Analysis of the Impact of Selected Fuel Thermochemical Properties on Internal Combustion Engine Efficiency," *Energy & Fuels* 26(5):2798-2810, 2012.

V. Kalyana Chakravarthy, C. Stuart Daw, and Josh A. Pihl, "Thermodynamic Analysis of Alternative Approaches to Chemical Looping Combustion," Energy and Fuels 2011, 25, pp 656–669.

C.S. Daw, R.L. Graves, R.M. Wagner, and J.A. Caton, "Report on the Transportation Combustion Engine Efficiency Colloquium Held at USCAR,", ORNL/TM-2010/265, October 2010.

Additional Presentations

Szybist, J.P., Steeper, R.R., Splitter, D.A., Kalaskar, V.B., Pihl, J.A., and Daw, C.S., "Negative Valve Overlap Reforming Chemistry in Low-Oxygen Environments," presentation at the AEC Program Review Meeting, Sandia National Laboratories, February 2014.

Szybist, J.P., Pihl, J.A., Daw, C.S., Bunting, B.G., "Preliminary Experimental Measurements of In-cylinder Fuel Reforming," presentation at the AEC/HCCI Working Group Meeting, Sandia National Laboratories, February 2012.

Critical Assumptions and Issues

- Address 3-5 of the critical assumptions and/or problems affecting the outcome of your project. Briefly describe the problem as well as potential solutions, both within and beyond the scope of the project.
- Exclude funding issues.

Note: This slide is for the use of the Reviewers only; it is not to be presented as part of your oral presentation. These Reviewer-Only slides will be included in the presentation file made available to Reviewers.

Critical Assumptions & Issues Slide Examples

CRITICAL ASSUMPTIONS AND ISSUES

- Past exhaust heat recovery concepts have not succeeded due to pressure drop, inadequate materials, complexity, and low power
  - New materials and reaction concepts (e.g., catalytic reforming and oxidation) have potential to address ΔP and materials problems
  - New mechanisms and control options (e.g., VVA, free piston, hybrid engines) are available to address complexity issues
  - Peak engine power is less of a concern for hybrids
- Reduction of combustion irreversibility does not necessarily lead to increased piston work
  - Concepts we select for further study retain exergy in the form of higher peak cylinder pressure rather than just higher temperature, thereby significantly increasing potential piston work
- Advanced ICE efficiency benefits are likely to be fuel specific
  - This is a major motivation behind including the analysis of fuel effects and inclusion of a range of catalysts and heat transfer materials in this study
- Current project isn't leading to near-term commercial products
  - The goal is to screen long-term advanced concepts and resolve basic questions as recommended by the 2010 USCAR Colloquium

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Critical Assumptions and Issues

- The surrogate electric vehicles used for the vehicle integration and testing phases employ the SAE J1772 standard for AC level 1 and level 2 charging. Due to market rollout plans and maturity of standards the surrogate electric vehicle also employs a CHAdeMO DC fast charging compliant charging infrastructure that the awardees will be utilizing on the vehicle side to communicate and deliver charge to the high voltage battery. This area of the system's design will be based on a modular architecture to allow application reuse when adjusting the system for vehicles adopting other standards.

Critical Assumptions and Issues

- Is low-temperature combustion a viable approach for meeting future emissions and efficiency targets?
  - Based on feedback from industrial partners, the consensus is that some level of low-temperature combustion deemed worthy of further research and development. Studies will include a range of EGR representative of uses across the industry, including strategies that use aftertreament.
- Relevance of results depends on state-of-the-art injector technology
  - As much as possible, we work with our industrial partners to use the most modern injector technology, but issues with proprietary content can cause some lag.
- Are optical engine results fully representative of production/metal engine performance?
  - The results of previous research, as well as the use of optical diagnostic observations for developing computer models, have demonstrated that fundamental research in optical engines is relevant to production engine performance. Future partnerships with parallel metal engine experiments and more realistic optical geometries are currently being explored.

COMBUSTION RESEARCH FACILITY ACE001 Musculus 27/25 Sandia National Laboratories